

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (currently amended) ~~Method~~ A method for controlling a synchronous mode to mode shift in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor adapted for imparting torque to the transmission, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, and fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied states wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising:

applying the one of the first and second torque transfer devices which is initially in a released state while controlling slip speed thereacross to substantially zero by adjusting motor torque to establish synchronous operation wherein slip speed across the first and second torque transfer devices is substantially zero and thereafter releasing the other one of the first and second torque transfer devices which is initially in an applied state while controlling slip speed thereacross to substantially zero by adjusting motor torque.

2. (currently amended) The method for controlling a synchronous mode to mode shift as claimed in claim 1 wherein controlling slip speed across the one of the first and second torque transfer devices which is initially in a released state to substantially zero by adjusting motor torque terminates when the one of the first and second torque transfer devices which is initially in a released state is fully applied.

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3. (currently amended) The method for controlling a synchronous mode to mode shift as claimed in claim 1 wherein controlling slip speed across the one of the first and second torque transfer devices which is initially in an applied state to substantially zero by adjusting motor torque terminates when the one of the first and second torque transfer devices which is initially in an applied state is fully released.

4. (currently amended) The method for controlling a synchronous mode to mode shift as claimed in claim 1 wherein controlling slip speed across torque transfer devices to substantially zero comprises controlling input member speed to a speed whereat the ratio of input member speed to output member speed is substantially said fixed ratio.

5. (currently amended) ~~Method~~ A method for controlling a shift from a first mode to a second mode in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied, and fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising:

applying an oncoming torque transfer device while controlling slip speed across the oncoming torque transfer device to substantially zero by adjusting motor torque and thereafter releasing an offgoing torque transfer device while controlling slip speed across the offgoing torque transfer device to substantially zero by adjusting motor torque, wherein applying the oncoming torque transfer device is initiated when a predicted period needed for full torque transfer device engagement is substantially equivalent to a predicted period for oncoming torque transfer device slip speed to reach zero.

6. (original) The method for controlling a shift as claimed in claim 5 wherein controlling slip

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speed across the oncoming torque transfer device to substantially zero by adjusting motor torque is initiated subsequent to initiation of applying the oncoming torque transfer device.

7. (original) The method for controlling a shift as claimed in claim 6 wherein controlling slip speed across the oncoming torque transfer device to substantially zero by adjusting motor torque is initiated a predetermined time prior to slip speed across the oncoming torque transfer device reaching zero.

8. (original) The method for controlling a shift as claimed in claim 7 wherein said predetermined time is a function of output member acceleration.

9. (original) The method for controlling a shift as claimed in claim 5 wherein said predicted period needed for full torque transfer device engagement is adaptively learned.

10. (original) The method for controlling a shift as claimed in claim 5 wherein said predicted period for oncoming torque transfer device slip speed to reach zero is determined from a trend in transmission speeds during said first mode operation.

11. (previously presented) The method for controlling a shift as claimed in claim 5 wherein said first mode of operation is preferred for low speed operation, said second mode of operation is preferred for high speed operation, and said shift is an upshift.

12. (previously presented) The method for controlling a shift as claimed in claim 5 wherein said first mode of operation is preferred for high speed operation, said second mode of operation is preferred for low speed operation, and said shift is a downshift.

13. (currently amended) ~~Mode~~ A mode to mode shift control for a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by

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simultaneous first torque transfer device applied and second torque transfer device released states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, and fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied states wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising:

a computer based controller for establishing motor torque in accordance with a control sequence including;

- a mode motor control during which said transmission is operating in one of said first and second modes and motor torque is used to control transmission input member speed to a target determined independent of speed across the torque transfer devices,

- a shift initiation motor control during which motor torque is used to control speed across the one of the first and second torque transfer devices which is initially in a released state to substantially zero, and

- a shift completion motor control during which motor torque is used to control speed across the other one of the first and second torque transfer devices which is initially in an applied state to substantially zero.

14. (previously presented) The mode to mode shift control as claimed in claim 13 wherein said control sequence further comprises a fixed-ratio motor control intermediate said shift initiation motor control and said shift completion motor control during which motor torque is not used in controlling transmission speeds.

15. (previously presented) The mode to mode shift control as claimed in claim 13 wherein said shift initiation motor control is terminated when the one of the first and second torque transfer

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devices which is initially in a released state is fully applied.

16. (previously presented) The mode to mode shift control as claimed in claim 13 wherein said shift completion motor control is terminated when the other one of the first and second torque transfer devices which is initially in an applied state is fully released.

17. (previously presented) The mode to mode shift control as claimed in claim 13 wherein said shift initiation motor control and shift completion motor control comprise controlling input member speed to a speed whereat the ratio of input member speed to output member speed is substantially said fixed ratio.

18. (currently amended) ~~Method~~ A method for controlling a mode to mode shift in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, and fixed-ratio operation characterized by simultaneous first and second torque transfer devices applied states wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising, in sequence:

establishing synchronous operation of the transmission by using motor torque to control slip across the one of the first and second torque transfer devices which is initially in a released state to substantially zero;

establishing fixed-ratio operation of the transmission by transferring torque being carried by said at least one motor during synchronous operation of the transmission to said one of the first and second torque transfer devices which is initially in a released state when

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said one of the first and second torque transfer devices which is initially in a released state has established sufficient capacity to accept said transfer of torque without slipping; and,
establishing synchronous operation of the transmission by transferring torque being carried by the other one of the first and second torque transfer devices which is initially in an applied state to said at least one motor.

19. (previously presented) A method for controlling a mode to mode shift as claimed in claim 18 wherein prior to establishing synchronous operation of the transmission, using motor torque to control transmission input speed to a predetermined input speed target.

20. (previously presented) A method for controlling a mode to mode shift as claimed in claim 19 wherein subsequent to transferring torque being carried by the other one of the first and second torque transfer devices which is initially in an applied state to said at least one motor, using motor torque to control transmission input speed to a predetermined input speed target.

21 (currently amended) The method of for controlling a synchronous mode to mode shift as claimed in claim 1, wherein the at least one motor comprises two electrical motors.

22. (currently amended) ~~The method for controlling a mode to mode shift as claimed in claim 1~~ A method for controlling a mode to mode shift in a multi-mode, electro-mechanical transmission including an input member and an output member, first and second torque transfer devices, at least one motor, first mode operation characterized by simultaneous first torque transfer device applied and second torque transfer device released states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, second mode operation characterized by simultaneous first torque transfer device released and second torque transfer device applied states wherein the transmission input member is mechanically coupled to the transmission output member through a continuously variable ratio, and fixed-ratio operation characterized by simultaneous

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first and second torque transfer devices applied states wherein the transmission input member is mechanically coupled to the transmission output member through a fixed ratio, comprising:
applying the one of the first and second torque transfer devices which is initially in a released state while controlling slip speed thereacross to substantially zero by adjusting motor torque and thereafter releasing the other one of the first and second torque transfer devices which is initially in an applied state while controlling slip speed thereacross to substantially zero by adjusting motor torque wherein applying the one of the first and second torque transfer devices which is initially in a released state is initiated when a predicted period needed for full torque transfer engagement thereof is substantially equivalent to a predicted period for slip speed thereacross to reach zero.

23. (previously presented) The method for controlling a mode to mode shift as claimed in claim 22 wherein controlling slip speed across the one of the first and second torque transfer devices which is initially in a released state to substantially zero by adjusting motor torque is initiated subsequent to initiation of application thereof.

24. (previously presented) The method for controlling a mode to mode shift as claimed in claim 23 wherein controlling slip speed across the one of the first and second torque transfer devices which is initially in a released state to substantially zero by adjusting motor torque is initiated a predetermined time prior to slip speed thereacross reaching zero.

25. (previously presented) The method for controlling a mode to mode shift as claimed in claim 24 wherein said predetermined time is a function of output member acceleration.

26. (previously presented) The method for controlling a mode to mode shift as claimed in claim 22 wherein said predicted period needed for full torque transfer engagement is adaptively learned.

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27. (previously presented) The method for controlling a mode to mode shift as claimed in claim 22 wherein said period for slip speed to reach zero is determined from a trend in transmission speeds during mode operation.

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